BALLISTIC MISSILE DEFENSE ORGANIZATION (BMDO)
SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR)

INTRODUCTION

The BMDO SBIR program is implemented, administrated and managed by the BMDO Office of the Chief Scientist. The Acting BMDO SBIR Program Manager is Frank Rucky. If you have any questions regarding the administration of the BMDO SBIR program please call 1-800-WIN-BMDO. Additional information on the BMDO SBIR Program can be found on the BMDO SBIR home page at http://www.winbmdo.com. Information regarding the Ballistic Missile Defense Organization's mission and programs can be found at http://www.acq.osd.mil/bmdo/bmdolink/html/.

GENERAL INFORMATION

The fundamental objective of the Ballistic Missile Defense (BMD) program is to develop the capability to defend the forces and territories of the United States, its Allies, and friends against all classes of ballistic missile threats. The goal of the BMD System (BMDS) is a layered defense that provides multiple engagement opportunities along the entire flight path of a ballistic missile. We will explore and demonstrate kinetic and directed energy kill mechanisms for potential sea-, ground-, air-, and space-based operations to engage threat missiles in the boost, midcourse, and terminal phases of flight. In parallel, sensor suites and battle management and command and control (BMC2) will be developed to form the backbone of the BMD System.

The boost phase is that part of flight when the ballistic missile's rocket motors are ignited and propel the entire missile system towards space. It lasts roughly 3 to 5 minutes for a long-range missile and as little as 1 to 2 minutes for a short-range missile. When the missile boosters are spent, the missile continues its ascent into what we call the midcourse part of flight (which lasts nominally 20 minutes for a long-range missile). In this stage of flight, a ballistic missile releases its payload warhead(s), submunitions, and/or penetration aids it carried into space. The missile enters what we call the terminal phase when the missile or the elements of its payload, for example, its warheads, reenter the atmosphere. This is a very short phase, lasting from a few minutes to less than a minute. There are opportunities and challenges to engage a threat missile in each of these phases.

The primary Terminal Defense Segment project is the Theater High Altitude Area Defense (THAAD) system. The mission of the THAAD System is to defend against short- and medium-range ballistic missiles at significant distances from the intended target and at high altitudes. This evolutionary program is structured to demonstrate capability in 2004, with planned improvements based on upgraded seekers, ground support equipment, and discrimination software. Current efforts are addressing component and system performance, producibility, and supportability.

The Midcourse Defense Segment program is divided into Ground-based Midcourse Systems and Sea-Based Midcourse Systems. The Ground-based Midcourse System has three objectives: 1) to develop and demonstrate an integrated system capable of countering known and expected threats; 2) to provide an integrated test bed that provides realistic tests and reliable data for further system development; and 3) to create a development path allowing for an early capability based on success in testing. The Sea-based Midcourse System is intended to intercept hostile missiles in the ascent phase of midcourse flight, which when accompanied by ground-based system, provides a complete midcourse layer. The Sea-based Midcourse System will build upon technologies in the existing Aegis Weapon System and the Standard Missile infrastructures and will be used against short and medium range threats.

The mission of the Boost Defense Segment is to define and develop boost phase intercept missile defense capabilities. To engage ballistic missiles in this phase, quick reaction times, high confidence decision-making, and multiple engagement capabilities are needed. The development of higher power lasers and faster interceptor capabilities are required. There are four principal objectives for the Boost Defense Segment. First, it will seek to demonstrate and make available the Airborne Laser (ABL). Second, it will define and evolve space-based and sea-based kinetic energy Boost Phase Intercept concepts. Third, this segment will execute a proof-of-concept Space-

Based Interceptor Experiment (SBX). Fourth, it will continue Space-Based Laser (SBL) risk reduction on a path to a proof-of-concept SBL Integrated Flight Experiment (SBL-IFX). Kinetic boost phase intercept is a challenge because the threat missile must be detected and confirmed within a few seconds of launch. It then becomes a race between an accelerating ballistic missile and the interceptor in which the threat missile has had a head start. Another technical challenge is designing a kill vehicle that can detect and track the target following missile-staging events and then impact the missile in the presence of a brilliant plume. We are considering a sea-based boost activity to develop a high-speed, high-acceleration booster coupled with a boost kill vehicle.

A satellite system intended to support missile defense operations is the Space-Based Infra-Red Sensor (SBIRS). SBIRS-Low, in conjunction with SBIRS-High (developed by the Air Force), form the SBIRS system, which will consist of satellites in Geosynchronous Orbits (GEO), Highly Elliptical Orbits (HEO) and Low Earth Orbits (LEO) and an integrated centralized ground station serving all SBIRS space elements and Defense Support Program (DSP) satellites. The focus of BMDO is on SBIRS-Low, which will incorporate new technologies to enhance detection; improve reporting of Intercontinental Ballistic Missile (ICBM), Sea-Launched Ballistic Missile (SLBM) and tactical ballistic missiles; and provide critical mid-course tracking and discrimination data for BMD.

Finally, the Science and Technology (S&T) Program will develop components, subsystems and new concepts needed to keep pace with the evolving ballistic missile threat. The primary focus of the Technology Segment is the development of sensors and weapons for future platforms that can complement today's missile defense capabilities. Specific projects include the development of a doppler radar to be used in a missile seeker, the demonstration of active and interactive midcourse discrimination techniques, the design and development of miniature kill vehicles for boost and midcourse application, and the development and/or testing of space relay mirrors for laser tracking systems. In addition to thrust area projects, investments are made in technology at the component level to improve the state-of-the-art in radars, infrared sensors, lasers, optics, propulsion, wide band gap materials, and photonic devices.

The intent of BMDO's Small Business Innovation Research Program is to seek out the most innovative technology that might improve the performance or reduce the cost of ongoing development programs in BMD. Proposing companies need not know specific details or requirements of specific BMDO systems; but in order for them to propose technology applications that may be relevant to ballistic missile defense programs, it will helpful for them to understand related research and development goals or specific technology needs.

The BMDO goal in Phase I is to pursue as many innovative research concepts and approaches as possible offering potential military as well as non-military applications as the result of commercialization for Government or private sector markets. The BMDO goal in Phase II is to develop those technologies that hold the most promise, considering feasibility, relevance, and transition opportunity. A strong indication of that promise is an identified sponsor for the proposed project (from government or industry) who will apply the demonstrated technology in a product to meet BMD needs.

PHASE I GUIDELINES

BMDO intends for Phase I to be only an examination of the merit of the concept or technology that still involves technical risk, with a cost under $70,000. Although proposed cost will not affect selection for negotiation, contracting may be delayed if BMDO determines that award should be made for less than the proposed cost. Do not submit the same proposal, or variations thereof, to more than one BMDO topic area. If BMDO decides that a proposal is relevant to another topic, the proposal will be passed on to reviewers in that topic area. It is strongly suggested that you do not use the title of the BMDO SBIR Topic as the title of your Phase I or Phase II proposal. Preferably, titles should reflect the innovativeness or other value added of your proposal in responding to a specific BMD need encompassed by the Topic.

Proposal Submission

Proposers are required to register and submit their entire proposal through the DoD Electronic Submission Website (http://www.dodsbir.net/submission). As instructed on the website, the proposal should include a BMDO Proposal

Cover Sheet, Cost Proposal, and Company Commercialization Report. Proposals shall be uploaded via the DoD Electronic Submission Website by the solicitation close date and time. Proposals sent by other means will not be accepted; hard copy submissions of Phase I proposals will no longer be accepted. Note, however, that a signed original of the Cover Sheet must be submitted by mail to the following address:

Ballistic Missile Defense Organization
ATTN: ST/SBIR (Rucky)
7100 Defense Pentagon
Washington, DC 20301-7100

Proposals and signed Cover Sheets received after the closing date will not be processed.

PHASE II GUIDELINES

Phase II is the demonstration of the technology that was found feasible in Phase I. BMDO selects awardees for Phase II developments through two competitive processes: a routine competition among Phase I awardees that have been invited to submit Phase II proposals; and a Fast Track competition for Phase I awardees that are able to propose independent funding as part of their Phase II application.

The BMDO SBIR PM or one of BMDO's executing agents for SBIR contracts will inform Phase I participants of their invitation to submit a Phase II proposal. Fast Track submissions do not require an invitation; see DoD's Fast Track guidelines. Phase II proposals may be submitted for an amount normally not to exceed $750,000. Companies may, however, identify requirements with justification for amounts in excess of $750,000. The preferred contract type for BMDO Phase II awards is Firm-Fixed Price.

Proposal Submission

If you have been invited to submit a Phase II proposal, please see the BMDO SBIR website http://www.winbmdo.com for further instructions. Starting this year, Phase II proposals for BMDO topics will be received and evaluated during one specific period of time. Companies who may choose not to submit Phase II proposals to meet the specific submission date are at liberty to submit proposals as part of the succeeding competition instead.

Phase I projects currently being performed will compete for Phase II awards according to the same guidelines as published at the time of the Phase I award. For SBIR projects selected under this solicitation, the following schedule will guide the submission and evaluation of Phase II proposals:

Phase II Key Dates

October 1-October 18, 2002: Submission of Proposals
October 21-November 22, 2002: Evaluation of Proposals
December 2002: First awards

By conducting two competitions annually and conducting evaluations on this expedited basis, BMDO expects to minimize lag times between completion of Phase I efforts and award of Phase II contracts. BMDO's executing agents may still exercise the prerogative, however, to arrange limited transitional funding to assist a successful Phase II competitor during the period prior to award of the Phase II contract.

SBIR Fast Track Program

The Fast Track Program is a Phase II option that is available for SBIR awardees that have attracted matching funds from a non-SBIR/non-STTR government program or an outside investor for the proposed Phase II SBIR effort. In

preceding years, BMDO offered a tailored Fast Track process (called "Fastrack"). That process will no longer be followed, and BMDO instead will participate in the DoD Fast Track program, as explained in the DoD solicitation.

SBIR Phase II Enhancement Policy

To encourage the transition of SBIR research into BMDO acquisition programs, BMDO has implemented a Phase II Enhancement Policy. Under this policy, BMDO will allow extension of an existing Phase II contract for up to one year and will provide additional Phase II funding of up to $250,000, either: 1) as matching funds for non-SBIR BMDO funds directed to the Phase II contract; or 2) as transitional funding in anticipation of Phase III, based on a letter of intent to the BMDO SBIR PM from a BMDO acquisition program that will award a Phase III contract.

Ballistic Missile Defense Organization Topics

BMDO/02-001 - Directed Energy Concepts and Components

BMDO/02-002 - Kinetic Energy Kill Vehicles and Components

BMDO/02-003 - Sensors and Surveillance

BMDO/02-004 - Manufacturing Sciences and Technology/Unit Cost Reduction

BMDO/02-005 - Non-Nuclear Power Sources and Power Conditioning

BMDO/02-006 - Propulsion and Logistics Systems

BMDO/02-007 – Thermal Management

BMDO/02-008 - Survivability Technology

BMDO/02-009 – Lethality and Vulnerability

BMDO/02-010 – Computer Systems, Algorithms, and Models/Simulations

BMDO/02-011 – Photonics

BMDO/02-012 – Structural Materials, Concepts, Components and Composites

BMDO/02-013 – not used

BMDO/02-014 - Electronics and Superconductivity

BMDO/02-015 – not used

BMDO/02-016 - Surprises and Opportunities

BMDO FY02 SBIR TOPIC DESCRIPTIONS

BMDO 02-001 Directed Energy Concepts and Components

Introduction: As part of BMDO's charter to provide for defense against future missile threats, various programs are created to further validate potential technologies to design, develop, and deploy systems in support of various efforts. These new programs provide future decision-makers an option to greatly enhance the capabilities of future TMD and NMD systems. BMDO investigates directed energy technologies for both TMD and NMD applications. As such, a significant investment is made each year in the continued development of increasingly sophisticated systems which may eventually find their utilization in a ballistic missile technology program or major defense acquisition program. All areas of the electromagnetic spectrum provide potential avenues toward finding and disabling a ballistic missile in flight. Furthermore, components, sub-components, and piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by the latest technology developments from industry. Current examples include the Space Based Laser and the Airborne Laser, and any other comparable sub-system, component, or subcomponent that can potentially support next generation developments. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

Description: BMDO seeks new, innovative and applied research toward advanced technology developments in the generation, propagation, and detection of directed energy in all forms and for the measurement of material properties of irradiated materials and structures. Dual-use systems under consideration include, but are not limited to, solid-state lasers (i.e. diode lasers), chemical lasers, excimer lasers, IR/Vis/UV lasers, agile lasers x-ray lasers, gamma-ray lasers, free electron lasers, particle beams, radio-frequency (RF) and millimeter wave (MMW) devices, and other unique hybrid approaches including explosively or electrically driven devices. Included herein are such topics as beam control, target acquisition, tracking and pointing, mirrors, beam propagation and steering, optics, antennas, conversion methods, quasi-phased matched non-linear optics (QPM NMO's), thermal management and heat removal for space, air, and ground based systems, countermeasures, coatings, deployable space optics, distributed apertures, and micro-optical-mechanical devices incorporating these aspects. Furthermore, any component or subcomponent that is utilized by any of these systems is of interest. Components, sub-components, or piece part specifics may be ground, air, or space based in their final application.

Phase I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

Phase II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

Successful Phase 3/Dual-Use Commercializers (Real-World Examples): Company A, whose advanced x-ray source is being utilized for waste sterilization, was sponsored from this topic. Company B utilized their tunable filters with the citrus industry and for military hyperspectral image applications.

DoD Key Technology Areas:

#1 --- Air Platforms
#5 --- Materials/Processes
#7 --- Sensors
#8 --- Electronics
#10--- Battlespace Environemnts
#11--- Space Platforms
#12 – Weapons
#13 – Nuclear Technology

BMDO 02-002 Kinetic Energy Kill Vehicles and Components

Introduction: Potential adversaries are expected to improve their ballistic missile systems and develop countermeasures to U.S. ballistic missile defense programs. The future designs of potential threat improvements that BMDO must address can not be determined explicitly. Broad-based kinetic energy interceptor technologies will potentially contribute to more than one program and possibly to more than one defense area. These kinetic energy weapons benefit from innovations offered in 1) discrimination, 2) sensors and seekers, 3) guidance, navigation and control, and 4) affordability. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

Description: Kinetic energy (KE) weapons candidates presently include a variety of ground and space based interceptor concepts. System elements include ground-based launchers, axial and divert motors/nozzles, smart projectile components, and endo/exoatmospheric guidance and control mechanisms. Technology challenges for KE systems include: high accuracy seekers;

active seekers; ultra-compact laser radar; dual mode (radar/IR or ladar/IR) seekers; simultaneous multispectral focal plane arrays (FPAs); wavelength-tunable FPAs; multicolor long wavelength FPAs; miniature hit-to-kill interceptors; finding the booster hardbody within a booster plume; high performance axial and divert propulsion sub-systems (especially very low mass divert and attitude control systems); miniature inertial navigation units; array signal processing; missile autopilots; long-range acquisition and multi-target tracking; distinguishing between lethal objects in the presence of decoys, chaff, aerosols, debris and other countermeasures (i.e. discrimination); electronic counter-countermeasure negation; lethality/miss distance; mitigating aero-optical effects and aero-thermal effects; optimal hit-to-kill homing navigation; shroud separation; IR window technology for hypervelocity endoatmospheric interceptors (including high temperature optical materials, self-compensating missile windows, low-cost AlON, and non-conventional window architectures); solid-state millimeter wave seekers; non-nuclear kill warhead performance; operations in a hostile environment; performance (including survivability of electronics); battle management; fire control; guidance and control; projectile launch survivability; and common among all systems reliability, producibility, safety (non-hazardous operation), maintainability, and lower-cost/lower-mass. New concepts and technologies that produce a much higher probability of hit-to-kill intercepts are required to support applications. Impact point selection technologies, instrumentation, concepts, and innovative methodologies are sought.

Phase I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

Phase II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

Successful Phase 3/Dual-Use Commercializers (Real-World Examples): Company C advanced the metal armature developments for military railgun efforts. Company D began with a bone implantation technology and international investments that resulted from divert motor rocket nozzles and have subsequently spun-out three other companies. Company E, with a market cap of $38M+, expanded with technology genesis from this topic to a dynamic frame seeker and chip-stacking developments. Company F supported ballistic missile defense efforts with their enhanced lethality kinetic energy projectile and has subsequently graduated out of the small business status, but continues to support the DoD in R&D efforts and was purchased by a Fortune 500 company Nov 1999.

DoD Key Technology Areas:

#1 --- Air Platforms
#5 --- Material/Processes
#10--- Space Platforms
#12--- Weapons

BMDO 02-003 Sensors and Surveillance

Introduction: BMDO investigates various sensor technologies for both TMD and NMD applications. As such, a significant investment is made each year in the continued development of increasingly robust and sophisticated sensor systems which may eventually find their utilization in a ballistic missile technology program or major defense acquisition program. All areas of the electromagnetic spectrum provide potential avenues toward finding and disabling a ballistic missile in flight. Furthermore, sensor systems, components, sub-components, and piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by the latest technology developments from industry. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

Description: Sensors and their associated systems/sub-systems will function as the "eyes and ears" for ballistic missile defense applications, providing early warning of attack, target detection/classification/identification, target tracking, discrimination, and kill assessment. New and innovative approaches to these requirements using unconventional and innovative techniques are encouraged across a broad band of the electromagnetic spectrum, from radar to gamma rays. Passive, active, and interactive techniques for discriminating targets from backgrounds, debris, and decoys, in the presence of chaff, aerosols, electronic countermeasures, and other penetration aids are specifically sought. Sensor-related device technology is also needed. Examples of some of the technology specific areas are: higher efficiency and higher power radar transmit/receive modules (employing GaN technology); advanced digital array radars; efficient radar cooling; lightweight radar antennas; long-life cryogenic coolers (open and closed systems); cryogenic heat transfer; superconducting focal plane detector arrays (for both the IR and sub-mm spectral regions); next generation focal plane arrays (FPAs); signal and data processing algorithms (for both conventional focal planes and interferometric imaging systems- ultraspectral or hyper spectral imaging); low-power optical and sub-mm wave beam steering; range-doppler lidar and radar; passive focal plane imaging (long-wavelength infrared to ultra-violet; novel information processing to maximize resolution while minimizing detector element densities); large format focal plane arrays (from UV to VLWIR); high sensitivity uncooled FPAs; advanced very long wavelength FPAs; interferometry (both passive and with active illumination); QWIPs; quantum wires and quantum dots; strained-layer superlattice detectors; integrated multispectral FPAs, gamma-ray detection; neutron detection; intermediate power frequency agile lasers; lightweight compact efficient fixed frequency radiation sources for space-based ballistic missile defense applications (UV-sub-mm wave), new optics and optical materials.

Entirely new and high-risk approaches are also sought. Please indicate the particular identifying letter your specific proposal/technology addresses:

BMDO/00-003**A** - Acoustic and Seismic
BMDO/00-003**B** - Radar and MMW
BMDO/00-003**C** - UV (<0.3 microns)
BMDO/00-003**D** - Visible (0.3 - 0.9 microns)
BMDO/00-003**E** - IR (>0.9 microns)
BMDO/00-003**F** - Gamma/X-Ray
BMDO/00-003**G** - Other

Phase I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

Phase II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

Successful Phase 3/Dual-Use Commercializers (Real-World Examples): Company G, with annual commercial sales of $15M+, is noted for its laser diode pumped Q-switched solid state laser products developed under this topic. Company H, with a market cap of $128M+, transferred its microwave based infrared detector and superconducting millimeter wave mixer technologies funded under this topic for a variety of cryogenic systems and products. Company OO's high power laser array transmitters are utilized on military and commercial satellites for communications. Company QQ, purchased by a larger company in Jun 00, received funding from this topic for their target surveillance, pointing, acquisition, and tracking sensors used by both military and civilian customers.

DoD Key Technology Areas:

#1 --- Air Platforms
#5 --- Material/Processes
#7 --- Sensors
#8 --- Electronics
#9 --- Battlespace Environments
#10--- Space Platforms
#11--- Human Systems
#12--- Weapons

BMDO 02-004 Manufacturing Sciences and Technology/Unit Cost Reduction

Introduction: BMDO continually investigates various diverse technologies for both TMD and NMD applications. As such, advanced technology demonstrations for affordability and advanced industrial practices to demonstrate the combination of both improved manufacturing process technologies and improved business methods are of interest. BMDO makes significant investments each year in the continued development of increasingly survivable, robust and sophisticated technology based systems. All areas of research, engineering, and manufacturing process technologies provide potential avenues toward finding and disabling a ballistic missile in flight. Furthermore, entire sensor systems, components, sub-components, or piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by the latest technology developments from industry. Proposed efforts funded under this topic may encompass any specific manufacturing process technology at any level resulting in a unit cost reduction. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

Description: BMDO seeks drastically lower unit cost of all components through manufacturing revolutions and through leveraging of high volume production from commercial sales. This will result in an improvement in the affordability of new ballistic missile defense systems and the development of cost effective methods to sustain existing developments while impacting the next generation of acquisition systems. Affordability is a significant factor in all aspects of the total life-cycle consideration of any military program. Innovative approaches that will allow BMDO to economically acquire new technologies for the next generation of ballistic missile defense systems and maintain these systems while providing for their upgrades will make total life-cycle costs more affordable. Whereas all other BMDO SBIR topics seek first and foremost a revolution in the military capability of the technology, this topic seeks only a revolution in the reduction of unit cost specifics. BMDO seeks herein only projects that are too risky for ordinary capital investment by the private sector. The proposals must include and will be judged, in part, on an economic analysis of the expected market impact and the viability of the product proposed. Incremental advancements will receive very little consideration. Innovative manufacturing technologies which reduce the cost per unit, repair, or remanufacturing/reengineering of entire sensor systems, components, sub-components, or piece part specifics are under consideration.

Phase I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

Phase II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

Successful Phase 3/Dual-Use Commercializers (Real-World Examples): Company J, with a market cap of $42M+, founded its technology developments under this topic with low-cost radioisotope-powered voltaic cells for military applications and a wide variety of other commercially viable electronic material based applications to include quantum-wire lasers.

DoD Key Technology Areas:

#1 --- Air Platforms
#5 --- Materials/Processes
#10--- Space Platforms
#12--- Weapons

BMDO 02-005 Non-Nuclear Power Sources and Power Conditioning

Introduction: New and unique non-nuclear power sources and new materials and electronics that provide for the efficient use of power are under consideration by BMDO for both TMD and NMD applications. New technology could conceivably provide support to future systems, which may eventually find their utilization in a ballistic missile technology program or major defense acquisition program. All areas of power technology, except nuclear power, provide potential avenues toward finding and disabling a ballistic missile in flight. BMDO SBIR shall not consider any nuclear power source proposal. Furthermore, entire power source systems, components, sub-components, and piece part specifics are constantly under evaluation by the various component TMD and NMD elements for replacement by the latest technology developments from industry. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

Description: New technologies for producing, storing and conditioning power which provide substantial improvements in lower recurring cost, lower mass, and/or smaller size are sought for all ballistic missile defense applications. New concepts for compact power sources and power conditioning devices for transportable or mobile systems at 200 kW to 1 MW also need to have high efficiency, low signatures, and high reliability. Power generation, power storage, and power conditioning devices that operate at cryogenic temperatures for use in a new concept for all cryogenic systems are sought. Space assets' power sources in the 0.5 to 5 kW power range, including solar arrays and their photovoltaic cells, need to tolerate high natural radiation levels. Energy storage systems, rechargeable fuel cells, or novel battery technologies with cycle lifetimes of up to 40,000 cycles are sought that may be utilized in low earth orbit sensor satellites, airborne platforms, or ground based assets. Onboard power sources for interceptor missiles that are periodically testable, have a quick start-up capability, and produce high power for short time intervals (up to five minutes). Power conditioning systems and components for space assets should provide very high efficiency.

Phase I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

Phase II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

Successful Phase 3/Dual-Use Commercializers (Real-World Examples): Company K, with a market cap of $22+, has provided for commercializing its self-restoring fault current limiter after it was incorporated into military efforts. Company MM, with a market cap of $714M+, has developed new solar cells with increased efficiencies that are utilized by both military and civilian interest.

DoD Key Technology Areas:

#1 --- Air Platforms
#5 --- Material/Processes
#4 --- Ground and Sea Vehicles
#10--- Space Platforms
#12--- Weapons

BMDO 02-006 Propulsion and Logistics Systems

Introduction: BMDO is constantly investigating various propulsion technologies for both TMD and NMD applications. Significant investments are made each year in the continued development of increasingly robust and responsive systems which may eventually find their utilization in a ballistic missile technology program or major

defense acquisition programs. All areas of propulsion technology provide potential avenues toward finding and disabling a ballistic missile in flight. Furthermore, entire propulsion systems, components, sub-components, and piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by the latest technology developments from industry. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

Description: In general, missile defense places unprecedented demands on all types of propulsion systems; for interceptors and satellites. Specifically, advancements are needed to achieve major reductions in the costs of placing and maintaining payloads in desired locations, high thrust boosters, non-toxic divert/attitude control systems. Approaches leading to techniques, methods, processes, and products in support of these propulsion and logistics objectives are sought. Advancements are needed in propulsion-related areas, e.g. extending storage time of cryogenic fluids (e.g. H2 and Xe) and, reduction of contamination from effluents. Areas of interest include the entire spectrum of space transportation and support: efficient launch systems for small technological payloads to very large system payloads; assembly and control systems; expendable and recoverable components; improved structures and materials; and increased propulsion efficiency. Low mass or miniature interceptors require advances in divert (small thrusters) propulsion systems (either solid or liquid). Boost phase interceptors need high thrust (10-50 G), low-mass boosters. High acceleration, low-mass divert and attitude control systems (DACS) greater than 5Gs are sought. High temperature nozzles and other DACS components are of great interest. Less hazardous propellants for DACS are also needed.

Phase I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

Phase II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

Successful Phase 3/Dual-Use Commercializers (Real-World Examples): Company L developed a laser radar tracking technology that finds commercial use in laser eye-surgery applications, but was also investigated for tracking ballistic missiles in flight.

DoD Key Technology Areas:

#1 --- Air Platforms
#5 --- Material/Processes
#10--- Space Platforms
#12--- Weapons

BMDO 02-007 Thermal Management

Introduction: BMDO constantly investigates various thermal management and cooling technologies for both TMD and NMD applications. Therefore, a significant investment is made each year in the continued development of increasingly robust and sophisticated heating/cooling system technologies, which may eventually find their utilization in a ballistic missile technology program or major defense acquisition program. Furthermore, thermal management (heating and cooling) systems, components, sub-components, and piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by the latest technology developments from industry. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

Description: Higher power levels of various ballistic missile defense assets must dissipate heat at state-of-the-art capabilities for waste thermal energy acquisition, transport, and dissipation to space. Technology advancements are required in thermal management for power generation systems, space platform payloads, heat pump radiators, laser diodes, diode fibers, slab lasers and an increased emphasis on all associated electronics including high power density wide bandgap devices. Some space platforms will require years of storage of large amounts of cryogen with minimum cryogenic loss and high cryogen delivery rates under condition of zero-g. As such, very long life space cryocoolers are of specific interest. Concepts, devices, and advanced technologies for all types of space-based power cycles are sought which can satisfy these projected ground/air/space platform requirements.

Phase I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

Phase II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

Successful Phase 3/Dual-Use Commercializers (Real-World Examples): Currently addressing electric vehicle technology applications for military and commercial interest, Company M got its initial start, and now with a market cap of $190M+, with active magnetic vibration isolation controls funded under this topic. Company SS developed a radiation hardened accelerometer that is used in the Safe-and-Arm device of the PAC-3 missile and by half of the automotive airbags in the U.S.

DoD Key Technology Areas:

#1 --- Air Platforms
#4 --- Ground and Sea Vehicles
#5 --- Materials/Processes
#10--- Space Platforms
#12--- Weapons

BMDO 02-008 Survivability Technology

Introduction: Missile defense elements must operate and survive against determined attacks. Threat actions can generate a reasonable set of hostile man-made environments before and during operations. Collateral environments and natural space environments (atomic oxygen, space radiation and micrometeorites/debris) provide additional technical challenges, which also affect civilian assets. Survivability engineering technology and survivability enhancement options are required to achieve a cost-effective, yet integrated solution to a dynamic and diverse set of hostile environments with a focus toward improving aspects of threat sensing, hardening, passive defense, and camouflage, concealment and deception (CCD). Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

Description: Sensor technologies enable the defense elements to detect nuclear events, laser and radio frequency weapon attacks, and to respond appropriately. Sensor technologies that can characterize the threat according to direction of attack, and spectral characteristics are currently under consideration. Technologies to enhance passive defense missile systems, ground/air/space assets, and support equipment are needed to operate against the threat support sensors, including radar, passive visible/IR sensors and seekers, and laser radar.

Passive hardening against the nuclear, laser, RF, ballistic and debris environments is specifically needed, in addition to novel radiation hardening technologies and approaches against the natural space environments. Sensor technologies and their associated systems, communications antennas (RF and laser), attitude sensors, solar power, propulsion, structure and thermal control are all directly exposed to nuclear, laser, RF and debris in addition to the natural space environments. Materials and component designs, which are intrinsically hard to these environments, and/or protective devices are needed, specifically with dual-use commercialization applications. A key ballistic missile defense area of consideration is seeker/sensor subsystems, the components of which (baffle materials, mirrors, optics, structures, focal plane arrays, read out electronics, and processing) must survive the laser, nuclear, IR, and natural environments, as well as, contamination from booster plumes and natural environments. Nuclear and laser hard concepts, materials, and devices for protection against unknown or agile lasers and rejection of RF energy. Structures and coatings providing appropriate thermal characteristics, stability under mechanical impulses and hardness to laser and RF radiation are needed. Processors, high-power ICs, and other electronic devices capable of operating in unique hostile environments presented by the strategic applications while retaining full functionality are desired. Long term space (commercial and government) applications are direct beneficiaries of these advanced technology developments. Countermeasures and integration of CCD technologies are particular useful to the operational forces and, in general, attempt to incorporate the latest military and commercial technologies to ensure an effective response to any advanced threat. Novel concepts and techniques that reduce the vulnerability of ballistic missile defense systems will increase the operational confidence level of dedicated assets. A new class of weapons technologies are evolving incorporating non-lethal methods. These have a broad range of applications as a survivability countermeasure or must themselves be countered to assure full operability. Non-lethal technology efforts in this area have dual-use applications.

Phase I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

Phase II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

Successful Phase 3/Dual-Use Commercializers (Real-World Examples): Company N, with a market cap of $2,300M+, got started with its hardened electronics for military environments and civilian applications. Company O markets holographic products to the commercial market that started with rugate filters for sensor protection of military optics.

DoD Key Technology Areas:

#1 --- Air Platforms
#5 --- Materials/Processes
#7 --- Sensors
#10--- Space Platforms

#12--- Weapons
#13--- Nuclear Technology

BMDO 02-009 Lethality and Vulnerability

Introduction: In implementing its TMD and NMD program activities, BMDO is continuing its developments of such efforts as the PATRIOT Advanced Capability-3 (PAC-3) missile system which has four major systems components: radar, engagement control station, launching station, and interceptors. The Navy Area Wide system will develop a sea-based capability that builds upon the existing AEGIS/Standard Missile air defense system. This system is based on the AEGIS-class cruisers and destroyers, which provide all elements of missile defense and are particularly suited to protecting forces moving inland from the sea. The Theater High-Altitude Area Defense System (THAAD) system will form the largest umbrella of missile protection in a specific theater, arching over all other missile defense systems. THAAD consists of four major systems components: truck-mounted launchers; interceptors; radar system; and battle management, command, control, communications, and intelligence (BMC3I). These increasingly sophisticated systems will provide the opportunity to destroy short and medium range ballistic missiles and other threats in the atmosphere far enough away that falling debris will not endanger friendly forces. The various BMDO technology and acquisition programs, in support of the TMD and NMD missions, are continually evaluating the latest advanced technology developments from industry as potential replacements for the current state-of-the-art sensor systems, components, sub-components, or piece part specifics. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

Description: A major factor in determining the effectiveness of a ballistic missile defense is the lethality of the directed energy and/or kinetic energy devices used against responsively hardened targets, bulk powder, and submunition targets. Battlefield by-products of post-intercept events are currently under consideration. New concepts and technologies that produce a much higher probability of hit-to-kill intercepts are required to support applications. Ground and Point-of-Intercept technologies, instrumentation, diagnostic developments and concepts, and innovative methodologies are under consideration for cost effective incorporation into BMDO lethality efforts. Additionally, novel concepts and techniques that reduce the vulnerability of ballistic missile defense systems will increase the operational confidence level of dedicated assets. Commercial applications may benefit from the incorporation of the techniques utilized in cost-reduction, measurement and diagnostics, and meteorology instrumentation packages.

Phase I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

Phase II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

Successful Phase 3/Dual-Use Commercializers (Real-World Examples): Company P was started after receiving initial funding under this topic for its solid-state optical devices, which are now commercially available products.

DoD Key Technology Areas:

#1 --- Air Platforms
#5 --- Materials/Processes
#10--- Space Platforms
#12--- Weapons

BMDO 02-010 Computer Algorithms, and Models/Simulations

Introduction: BMDO investigates various computer technologies in support of both TMD and NMD applications. As such, a significant investment is made each year in the continued development of increasingly robust and sophisticated battle management, command, control, and communications (BMC3I) systems which may eventually find their utilization in, and support of a ballistic missile technology program or major defense acquisition program. All areas of computer software development provide potential avenues toward supporting the ability of future BMDO systems to find and disable a ballistic missile in flight. Furthermore, complete computer systems, components, sub-components, and piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by the latest technology developments from industry. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

Description: Missile defense systems for advanced battle management demand order-of-magnitude advances. A system must potentially acquire and track thousands of objects with many networked sensors and data processors, and must employ direct weaponry to intercept targets, and determine the degree of kill. Areas of specific interest include:

- New computer architectures which are robust, compact, and fault-tolerant, but allow for the extremely rapid processing of data. Architectures may be implemented by new designs or innovative applications of existing technologies, such as optical signal processing, systolic arrays, neural networks, etc.

- Very high-level language (VHLL) design for both the development and testing of extremely large software systems.
- Novel numerical algorithms for enhancing the speed of advanced data processing for sensing, discrimination, kill assessment, and systems control. These may be specifically tailored to a particular task (for instance, the execution of a phase retrieval algorithm for interferometric imaging or advanced engagement planning) and may include neural networks.
- Language design to develop code optimized for highly parallel processed architectures.
- Software engineering processes, methods, tools, and environments for next generation revolutionary paradigms. Areas of interest include: decision architectures; COTS-based development; risk management; sizing and costing estimation; measurement; affordability; supportability; quality; development and acquisition processes; and "Best Practices" for requirements specification/management, design, development, integration, testing, configuration management, and support of real-time distributed large-scale software systems.
- Software product line technologies, including domain analysis and engineering, software product line acquisition planning, component evaluation and cataloguing, organizational reuse assessments, and software product line risk management.
- Testing techniques that will provide a high level of confidence in the successful operation of concurrent, real-time, distributed large-scale software systems. Examples include sensitivity analysis, data flow testing, mutation testing, static concurrency analysis, dependency analysis, and novel techniques for early detection of errors.
- Computer network and communications security. Areas of interest include: intrusion-tolerant architectures; intrusion monitoring, detection, and defense; rapid recovery methodologies; ”self-healing” systems capable of isolating corrupted nodes, re-allocating resources, and reconstituting lost information; R&D for trusted computer systems.
- Self-adaptive processing, simulations, and unconventional computing approaches. Algorithms and architectures for advanced decision-making. Data compression and adaptive bandwidth management techniques.
- Neurocomputing and Man-Machine Interface - rule-based artificial intelligence and neural networks combined for decision making flexibility and system robustness; development of decision trees and information display for highly, automated, short response time, training adaptive high volume scenarios development of autonomous intelligent agents and self-learning decision aids which operate in distributed heterogeneous environments.
- Software architectures for embedded computer networks that especially facilitate incremental system and software integration, hardware and software maintenance, and system evolution, without significant performance degradation.
- Hardware and software self-diagnostic capabilities for monitoring the operational readiness and performance of space, air, and ground systems incorporating embedded computer networks. Novel testing tools and evaluation methods supporting T&E capabilities.
- Virtual environments to allow diverse groups to interact in real time and in increasingly realistic ways over large distances which may include: hostile environments definition and ground effects modeling and simulation efforts. Real-time distributed database management.
- Advanced interface effectors, including visualization, multi-sensory, and virtual reality technologies, for total information presentation and improved situational awareness in missile defense application areas.
- Advanced knowledge representations and probabilistic behavior models for realistic, high performance knowledge-based decision aids.
- Software probes, gauges, and related software architectures and algorithms that support software/system re-composition to enable self-adaptive, self-healing computer-based systems.
- Application independent, customizable/adaptable middleware for real-time coordination and synthesis in networked embedded systems. Coordination services include fault tolerant, self-stabilizing protocols for time, data exchange, synchronization, and replication in large, distributed, real-time systems. Synthesis services provide time-bounded solution for complex, distributed constraint satisfaction tasks required for dynamic reconfiguration of applications.
- Model-based generation & composition technology: Includes methods and tools for modeling, composing, verifying and synthesizing model-based generators with domain-specific front-ends and platform/framework-specific back-ends; methods and tools for coupling and composing customizable frameworks.

Phase I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

Phase II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

Successful Phase 3/Dual-Use Commercializers (Real-World Examples): Company Q, with commercial and military sales of its automatic parallelization tool for sequential programs, marketed as *INSURE++* and *CodeWizard for Java*, is in excess of $10M/year.

DoD Key Technology Areas:

#1 --- Air Platforms
#3 --- Information Systems Technology
#10--- Space Platforms

#11--- Human Systems
#12--- Weapons

BMDO 02-011 Photonics

\Introduction: In implementing its TMD and NMD program activities, BMDO is continuing its developments of such efforts as the PATRIOT Advanced Capability-3 (PAC-3) missile system which has four major systems components: radar, engagement control station, launching station, and interceptors. The Navy Area Wide system will develop a sea-based capability that builds upon the existing AEGIS/Standard Missile air defense system. This system is based on the AEGIS-class cruisers and destroyers, which provide all elements of missile defense and are particularly suited to protecting forces moving inland from the sea. The Theater High-Altitude Area Defense System (THAAD) system will form the largest umbrella of missile protection in a specific theater, arching over all other missile defense systems. THAAD consists of four major systems components: truck-mounted launchers; interceptors; radar system; and battle management, command, control, communications, and intelligence (BMC3I). These increasingly sophisticated systems will provide the opportunity to destroy short and medium range ballistic missiles and other threats in the atmosphere far enough away that falling debris will not endanger friendly forces. The various BMDO technology and acquisition programs, in support of the TMD and NMD missions, are continually evaluating the latest advanced technology developments from industry as potential replacements for the current state-of-the-art sensor systems, components, sub-components, or piece part specifics. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

Description: Dense computing capability is sought in all architectural variations, from all optic to hybrid computers. Specific examples of areas to be addressed include, but are not limited to, high speed multiplexing; monolithic optoelectronic transmitters; holographic methods; reconfigurable interconnects; in-plane optical connections; optoelectronic circuits; and any other technology contributing to advances in intra-computer communications; optical logic gates; bistable memories; optical clock oscillators; optical transistors; low-insertion,low-guide, and minimized bend losses; and power limiters. Also, under consideration are non-linear optical materials advancements and new bistable optical device configurations. Solutions that enable easy bi-directional opto-electronic conversion from vertical to in-plane interconnect schemes offer the ultimate in performance, I/O density and flexibility of design for system coupling. Please indicate the particular identifying letter that your specific proposal/technology addresses:

BMDO/ 02-211**A** – Optical Materials
BMDO/ 02-211**B** – Optical Devices

Phase I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

Phase II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

Successful Phase 3/Dual-Use Commercializers (Real-World Examples): Company R took a unique technology approach in addressing fiber-optic and other optical communications applications to both the military and commercial industry. Company S is providing a low-loss electro-optical switching array, Company T is providing optical bus extenders and fiber-optic modulators, Company U has funded technology which utilized wavelength division multiplexing techniques; all three support the ever growing optical communication industry.

DoD Key Technology Areas:

#1 --- Air Platforms
#3 --- Information Systems Technology
#5 --- Materials/Processes
#10--- Space Platforms
#12--- Weapons

BMDO 02-012 Structural Materials, Concepts, Components and Composites

Introduction: The tremendous explosion in the commercial industry to develop innovative structural components has sustained BMDO investigations into various technologies in support of both TMD and NMD applications. As such, a significant investment is made each year in the continued development of increasingly robust and viable concepts which may produce technologies that eventually find their utilization in, and support of, a ballistic missile technology program or major defense acquisition program. The commercial industry has made advances in the development of stronger, lighter, and cheaper materials for use in structural applications. BMDO investigates various composites technologies for both TMD and NMD missile applications. All considered technologies provide potential avenues toward supporting the ability of future BMDO systems to address vibrations and structural integrity more efficiently than current methods will allow. Furthermore, components, sub-components, and piece part specifics are constantly under evaluation by the various TMD and NMD elements for replacement by

the latest technology developments from industry. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

Description: Minimum weight structures are needed in ballistic missile defense applications to withstand high-g loading, acoustic and thermal environments of ground based interceptors, and to provide solid bases for space systems pointing and tracking. Such structures will benefit from: (1) innovative vibration control techniques, (2) innovative fabrication approaches to cut structure cost, (3) innovative use of advanced materials and/or design approaches to minimize structure weight, and (4) innovative rapid prototyping techniques. For instance, techniques and experimental verification are needed for active and/or passive methods to measure and control vibrations caused by thermo-mechanical flutter, thruster firing, or structure borne noise caused by on-board mechanisms, multipurpose structures that provide mechanical strength, electrical connection, and desired thermal characteristics, kill enhancement materials that increase the energy imparted to objects impacted. "Active" structural elements containing materials and electronics to provide predictable mechanical displacement in response to applied electrical signals are of interest. Maximization of displacement, mechanical strength, and reliability; parameter stability over extended temperature ranges; and minimization of driving voltage, power, and weight of these elements are desired. Producibility improvements for curved actuator elements, flextensional, and other integrated motion amplifiers are of interest. Fabrication approaches that provide minimum weight with reduced assembly, inspection, and scrap rates for conventional, advanced composite, and "active" structures are needed to reduce costs. The following are also sought: innovative manufacturing methods for producing high modulus, fiber-reinforced glass, light metal (i.e. aluminum or magnesium), or resin matrix composites; innovative procedures for the production of instrumentation, sensors, and software for on-line process monitoring and evaluation of high modulus, fiber-reinforced composites during fabrication; novel approaches to tailor fiber/matrix interfaces to maximize capability in advanced composites; novel methods to cut fabrication cost of metallic and/or composite spacecraft and interceptor structures; innovative tooling techniques for near-net shape production of advanced composites; novel low-to-no outgassing joining/bonding techniques for advanced composites; adhesives; innovative surface modifications to promote wear resistance and supersonic test techniques to evaluate wear and erosion; new methods for integrating instrumentation (e.g., embedded sensors) into advanced composite materials and structures; novel instrumentation for determination and telemetry of material properties and data from space. Advances are also sought in materials for optical system components, mechanical moving assemblies, and protective coatings. Of course, novel designs and material usage to reduce structure weight, while maintaining or increasing capability, are always desirable goals.

Phase I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

Phase II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

Successful Phase 3/Dual-Use Commercializers (Real-World Examples): Company V took its ultrasonic motor technology to the commercial industry and their motor can now be found in assorted novelty and gift items. Company W, with a very accurate and precise gimbal for military laser communications, also has sales to the commercial optical communications industry.

DoD Key Technology Areas:

#1 --- Air Platforms
#5 --- Materials/Processes
#10--- Space Platforms
#12--- Weapons

BMDO 02-014 Electronics and Superconductivity

Introduction: In implementing its TMD and NMD program activities, BMDO is continuing its developments of such efforts as the PATRIOT Advanced Capability-3 (PAC-3) missile system which has four major systems components: radar, engagement control station, launching station, and interceptors. The Navy Area Wide system will develop a sea-based capability that builds upon the existing AEGIS/Standard Missile air defense system. This system is based on the AEGIS-class cruisers and destroyers, which provide all elements of missile defense and are particularly suited to protecting forces moving inland from the sea. The Theater High-Altitude Area Defense System (THAAD) system will form the largest umbrella of missile protection in a specific theater, arching over all other missile defense systems. THAAD consists of four major systems components: truck-mounted launchers; interceptors; radar system; and battle management, command, control, communications, and intelligence (BMC3I). BMDO's increasingly sophisticated systems will provide the opportunity to destroy short and medium range ballistic missiles and other threats in the atmosphere far enough away that falling debris will not endanger friendly forces. The various BMDO technology and acquisition programs, in support of the TMD and NMD missions, are continually evaluating the latest advanced technology developments from industry as potential replacements for the current state-of-the-art sensor systems, components, sub-components, or piece part specifics. Research or Research and Development efforts selected under this topic shall

demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

Description: The necessary advances in electronics for the many ballistic missile defense applications will require advances in electronics materials. Primary emphasis lies in advancing the capability of integrated circuits (>GB/s), detectors, sensors, large-scale integration, radiation hardness, and all electronic components. Novel quantum-well/superlattice structures that allow the realization of unique elective properties through "band gap engineering" are sought, as are new organic and polymer materials with unique electronic characteristics. In addition, exploitation of the unusual electronic properties of gallium nitride is of considerable interest, as well as, dramatic improvements of growth processes. Specific interests include, high speed switching conditions at >10GHz and/or cryogenic temperatures. Also, for high power, <10 GHz, SiC should be pursued for both semi-insulating bulk and epitaxial growth. Among the many BMDO electronic needs and interest are advances in high frequency transistor structures, solid state lasers, optical detectors, thermochromic films, low dielectric constant packaging materials, mixed-signal electronics, tailored thermal conductivity, microstructural waveguides, multilayer capacitors, single-electron transistors, clock-less logic ICs, metallization methods for repair of conducting paths in polyceramic systems, and sol-gel processing for packaging materials. Also, BMDO is interested in demonstrating both high temperature superconductor (HTS) and low temperature superconductor (LTS) devices to enable or improve strategic defenses. Emphasis in HTS technology focused toward components integrated with state-of-the-art cryoelectronics for communications systems at K- and S-bands and radar systems in the X-band power and inductive energy storage are of specific ballistic missile defense interest. The demonstration of HTS materials toward limited detection of radiation in the optical, IR, MWIR, and LWIR bands as well as for signal processing applications is also of interest. The emphasis in LTS technology is in the development and demonstration of high sensitivity detectors, digital electronics, and memory enabling on-focal plane array signal processing and operating at temperatures greater than 10K. Additionally, superconducting power technologies are of interest. Efforts should address packaging and interface issues and systems integration with cryocoolers and stored cryogens. Please indicate the particular identifying letter that your specific proposal/technology addresses:

BMDO/ 02-214**A** – Electronic Materials
BMDO/ 02-214**B** – Electronic Devices
BMDO/ 02-214**C** – Superconductivity Materials
BMDO/ 02-214**D** – Superconductivity Devices

Phase I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

Phase II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

Successful Phase 3/Dual-Use Commercializers (Real-World Examples): Company Y, with a market cap of $883M+, commercialized technology that allowed for the delivery of ultra-pure materials to semiconductor thin film reactors and has graduated from small business status. Company Z, with a market cap of $14M+, manufactures radiation detection devices and was funded for avalanche photodiode arrays under this topic. Company AA, with a market cap of $1,200M+, has a substantial market share of the atomic layer epitaxy growth method of semiconductor compound materials based on their efforts developed under this topic. Company BB, with a market cap of $692M+, which manufactures flat panel display devices, received some initial funding for their silicon-on-insulator films and organometallic chemical vapor deposition technology developments. Company CC, purchased by a Fortune 100 company Apr 00, commercialized technology based on degradation resistant laser diodes. Company DD, with a market cap of $7M+, is commercializing technology based on its surge suppression devices and marketed as SurgX. Company EE, purchased by another larger company Feb 01 after graduating from small business status, had initial funding for its high bandgap compounds and laser diode products to develop a number of commercial and military products. Company KK established a multilayer coating technology, on which they have the worldwide patent, that can be easily transported to any location for application. Company FF developed a magnetoresistive non-volatile random access memory chip, which is also radiation hardened, and is utilized in a number of space applications for the military and commercial sectors. Company LL, with a market cap of $133M+, was started with their first Phase I from this topic and the products are used in electronics, structural ceramics, composites, cosmetics and skin care, and as industrial catalysts. Company NN, with a market cap of $574M+, is leveraging technology developed under this topic for the efficient production of semiconductors from waste recovery during the manufacturing process. Company GG, with a market cap of $113M+, fabricates optical components for industrial and military applications finds traceability back to superconducting detectors funded under this topic. Company HH, with a market cap of $103M+, demonstrated success from its technology based on multi-GHz superconducting shift registers.

DoD Key Technology Areas:

#1 --- Air Platforms
#5 --- Materials/Processes
#7 --- Sensors
#8 --- Electronics
#9 --- Battlespace Environment
#10--- Space Platforms

#12--- Weapons
#13--- Nuclear Technology

BMDO 02-016 Surprises and Opportunities

Introduction: BMDO increasingly depends on advanced technology developments, of all kinds, to invigorate its ability to find and disable missiles in flight and to defend against an increasingly sophisticated threat, to include cruise missiles. Therefore, the continued availability of emerging technology has become a vital part of the BMDO mission. BMDO has interest and investments in specific technology programs that pursue speculative, high-risk technologies that could spur a revolutionary leap or enhancements in either Theater Missile Defense or National Missile Defense capabilities. Specific goals include, but are not limited to, quickening the pace of technology and innovation developments and decreasing the time required to transform scientific breakthroughs into actual applications. Research or Research and Development efforts selected under this topic shall demonstrate and involve a degree of technical risk where the technical feasibility of the proposed work has not been fully established.

Description: Since ballistic missile defense is an exploration at technology's leading edge to begin with, BMDO recognizes that surprises and opportunities may arise from creative and innovative minds in a variety of technology sectors. BMDO will consider proposals in other technologies where they present a completely unique and unusual opportunity for ballistic missile defense applications. The proposing company should take special care to describe the specific technology in complete detail and specify why ballistic missile defense applications would benefit from exploring its unique and novel implications. Proposing companies should make particular note that proposals in this topic will receive preliminary screening at BMDO and that they may be rejected as too far afield without the benefit of a full technical review received by proposals in the topics already listed. It is recommended that the proposing company focuses their submission toward one of the specific outlined topics above unless the technology proposed is truly an unquestionable innovation. This full and open call is for new/novel/innovative/unique advanced technology developments, and not for the recycling of old ideas, incremental advancements, or questionable improvements.

Phase I: Demonstrate the likelihood that a new and innovative research and development approach can meet any of the broad needs discussed in this topic for future BMDO systems consideration.

Phase II: Develop applicable and feasible prototype demonstrations and/or proof-of-concept devices for the approach described, and demonstrate a degree of commercial viability.

Successful Phase 3/Dual-Use Commercializers (Real-World Examples): Company JJ, with a market cap of $999M+, was funded for technology to further its intelligent client-server software solutions for mission-critical decision applications in real-time military and commercial environments.

DoD Key Technology Areas: Any potential new development may address a DoD Critical Technology Area from this topic, provided it supports BMDO mission interest at some level. DoD Key Technology Areas:

#1 --- Air Platforms
#3 --- Information Systems Technology
#4 --- Ground and Sea Vehicles
#5 --- Materials/Processes
#7 --- Sensors
#8 --- Electronics
#9 --- Battlespace Environment
#10--- Space Platforms
#11--- Human Systems
#12--- Weapons
#13--- Nuclear Technology